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$$CD:AC=BC:AB, \text{ or } CD:a=b:c,$$

from which $CD=ab/c$, which agrees with result (2).

Also solved by *J. R. HITT*, *J. SCHEFFER*, and *G. B. M. ZERR*.

CALCULUS.

144. Proposed by *G. B. M. ZERR*, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Find volume common to the two solids

$$[x/a]^{\frac{2}{3}} + [y/b]^{\frac{2}{3}} = [z/c]^{\frac{2}{3}}, \quad [y/b]^{\frac{2}{3}} + [z/c]^{\frac{2}{3}} = [x/a]^{\frac{2}{3}}.$$

Solution by the PROPOSER.

From the equations $[x/a]^{\frac{2}{3}} + [y/b]^{\frac{2}{3}} = [z/c]^{\frac{2}{3}}$ and $[y/b]^{\frac{2}{3}} + [z/c]^{\frac{2}{3}} = [x/a]^{\frac{2}{3}}$ we find the limits of z to be $z=c\{[x/a]^{\frac{2}{3}} + [y/b]^{\frac{2}{3}}\}^{\frac{3}{2}}$ to $z=c\{[x/a]^{\frac{2}{3}} - [y/b]^{\frac{2}{3}}\}^{\frac{3}{2}}$. Eliminating z we get

$$y = \pm \frac{b}{\sqrt[3]{8}} \left[\frac{x}{a} \right]^{\frac{1}{3}} \{1 - [x/a]^{\frac{2}{3}}\}^{\frac{3}{2}} = y'.$$

The limits of x are $x=0$ to $x=a$.

$$\therefore V = 2c \int_0^a \int_0^{y'} [\{(x/a)^{\frac{1}{3}} - (y/b)^{\frac{2}{3}}\}^{\frac{3}{2}} - \{(x/a)^{\frac{2}{3}} + (y/b)^{\frac{2}{3}}\}^{\frac{3}{2}}] dx dy.$$

Let $x/a=u^3$, $y/b=v^3$.

$$\therefore V = 18abc \int_0^1 \int_0^{v^{\frac{1}{2}u(1-u)}} u^2 v^2 \{(u-v^2)^{\frac{3}{2}} - (u^2+v^2)^{\frac{3}{2}}\} du dv$$

$$= \frac{3}{8} abc \int_0^1 \left(u^2 (2+u+2u^2) \sqrt{1-u^2} - 8(1-u^2)^{\frac{5}{2}} + 3u^2 \sin^{-1} \left[\frac{1-u}{2} \right] \right.$$

$$\left. + 6u^5 \log \left[\frac{1+\sqrt{1-u^2}}{u} \right] \right) u^3 du$$

Let $u=\cos\theta$.

$$\therefore V = \frac{3}{16} abc \int_0^{\frac{1}{2}\pi} (4\cos^2\theta \sin\theta + 2\cos^3\theta \sin\theta + 4\cos^4\theta \sin\theta - 16\sin^5\theta + 3\theta \cos^2\theta$$

$$+ 12\cos^5\theta \log \left[\frac{1+\sin\theta}{\cos\theta} \right]) \cos^3\theta \sin\theta d\theta = \frac{115\pi abc}{2048}.$$